SEARCH REPORTの引例 2

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.:—**H 01** q 19/06.

COMPLETE SPECIFICATION

Directional aerial for flying bodies

We, BOLKOW *GMBH*, a Company organised and existing under the laws of Western Germany, of Ottobrunn bei München, 8 München 8, Western Germany, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a directional aerial for flying bodies, such as missiles which are automatically controlled or aircraft, which aerial is particularly suitable for use in the cm and mm wavelength range.

Known directional aerials which are mounted in the nose of a flying body are aerodynamically faired with a so-called radome, as the directional aerials are completely unsuitable as the nose of a flying body. A radome of this type, however, must consist of a dielectric and, for strength, have a certain minimum wall thickness. Apart from the additional weight, this means that the electromagnetic radiation when passing through the radome, is attenuated and refracted. If the directional aerial forms part of a radar system, for example, difraction reduces the measuring accuracy and results in an apparent angular change in the direction of a target, as the degree and the direction of the refraction are not constant over the entire radome. Furthermore, reflections take place within the radome which influence the transmitting frequency and increase the side lobe radiation. The material normally used for radomes has a dielectrical constant ϵ of between 4 and 7 and a loss angle, tan δ, of about 0.02. These constants, however, are extremely unfavourable for the purpose in view. (Cf. "Airborne Radar", 1960, pp. 531-535).

The object of this invention is to provide a directional aerial for flying bodies which will not require a radome for protection against atmosphere or for its aerodynamic fairing.

Dielectric lens-type aerials are known, of which the shape, as is known, is plano-convex in the case of the so called retardation lenses and plano-concave in the case of so called acceleration lenses (cf. "Taschenbuch der Hochfrequenztechnik" ("H.F. Technique Handbook"), Meincke/Gundlach, published by Springer, 1962, pp. 609-611; "Bell Laboratories Record", Kock, May 1956, pp. 193 et seq; Proceedings IRE November 1946, pp. 828 et seq; Aug. 1949, pp. 852 et seq). Generally in such lens-type aerials the feed side, i.e. the side facing the emitter, has a curved surface. This simplifies the calculations for the curvature of the lens and enables the thickness to be kept small, a very important point in view of the saving in weight which can thus be achieved in the case of lens-type aerials of large diameter.

According to this invention there is provided a directional aerial for flying bodies, particularly for use in the cm and mm wavelength range, comprising a primary horn radiator and an axially symmetrical dielectric retardation lens having a non-convex surface facing the primary radiator, the focal length and refractive index of the lens being such that the other surface of the lens forms the nose of the flying body.

The retardation lens of the directional aerial according to the invention receives radiation at the plane or concave side. This results in a lens of greater thickness with a considerable degree of curvature, which is readily formed as part of the air frame of a flying body, provided the speed of the latter remains in the subsonic or lower supersonic range. This surprisingly simple method enables a radome to be dispensed with. The

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increase in the weight of the lens type aerial of this kind is of no great importance, since the large and heavy radome hitherto required is of course eliminated.

As the aerial system cannot be pivoted mechanically, as is possible with a parabolic reflector aerial system inside a radome, the main direction of radiation of the aerial in relation to its axis is pivoted electronically.

If the main direction of radiation of the directional aerial is inclined with respect to the longitudinal axis of the flying body, then rotary motion of a flying body about its longitudinal axis can be used for scanning the area in the direction of flight.

In a further development of the invention the convex part of the retardation lens, which part acts as a radome, is provided with a harder dielectric coating which forms part of the lens, as a protection against wear.

The primary emitter used is preferably a pyramid-shaped horn which extends substantially to the rear edge of the retardation lens, in order to keep side lobes as small as possible.

The dielectric constant and thus the refraction index of the retardation lens is kept as small as possible with sufficient mechanical strength in the lens material.

Further details of the invention will be apparent from the following description taken in conjunction with the accompanying drawings. In the drawings:—

Figure 1 shows a known lens type directional aerial;

Figure 2 shows one form of directional aerial in accordance with the invention;

Figure 3 shows another form of a directional aerial in accordance with the invention, and

Figure 4 shows a directional aerial in accordance with the invention provided with a means for deviating the radiation electronically.

In the known type of directional aerial shown in Figure 1, a horn-type radiator 10 is provided, the convex side 11*a* of a dielectric retardation lens 11 faced towards the radiator. A retardation lens of this type is characterised by a small thickness, d.

In one form of directional aerial according to the invention, as shown in Figure 2, a primary radiator 20 which is for example a horn-type radiator, faces towards a dielectric retardation lens 21. In this case the convex side 21*b* is curved to a greater extent than that shown in Figure 1, and faces away from the primary radiator 20. The focal length F and the refractive index n of the retardation lens are such that its convex surface can form the nose of a flying body or aircraft. This involves an increase in the thickness d of the retardation lens and thus its weight, although these increases, as already described, are of no disadvantage. The degree of curvature required in the external contour of the retardation lens, which contour replaces an otherwise customary radome, i.e. according to the degrees of curvature required in that part of the retardation lens which faces away from the primary emitter, is calculated from known laws; shorter focal lengths resulting in a thicker lens.

As shown in Figure 3, a primary emitter 30 is provided which faces a concave side 31*a* of a retardation lens 31. As shown the curvature of the axially symmetrical lens forms a circle of radius R at the feed side 31*a*, and an ellipse at the outlet side 31*b*. The emitter 30 extends approximately to the edge of the lens, so that the side lobes of the directional aerial are particularly well suppressed. The convex external contour 31*b* of the retardation lens is immediately followed, without any transition, by the fuselage of a flying body 32, indicated by broken lines.

In order to protect the external surface of the lens against wear, it is provided with a very thin and hard coating 33 of another dielectric, selected to ensure that it will have no particular effects on the properties of the retardation lens.

For many purposes it is desirable for the principal direction of radiation of the aerial to be deviated from its axis. As the retardation lens is in each case rigidly connected with the flying body (Figure 3), the direction of radiation can only be pivoted by electronic means.

As shown in Figure 4, a primary emitter 40 towards which the plane side 41*a* of a lens 41 faces, is fed by two adjacent hollow conductors 42 and 43, each of which carries half the transmitting power. In the hollow conductor 43, which is the front conductor from the point of view of Figure 4, there is a ferrite phase shifter 44 which can be energized by a coil 45. As the phase of the radiation emerging in the front can be shifted in respect of that emitted at the rear, by altering the current flowing through the coil 45, this enables the radiation to be deviated. A deviation of this kind can be carried out both in the E-wave plane and in the H-wave plane.

If the main direction of radiation of the directional aerial has been deviated through a certain angle with respect to the longitudinal axis of the flying body, then the scanning of the area in the direction of flight can be carried out by the rotary movement of a flying body rotating about its longitudinal axis.

A directional aerial in accordance with the invention can be made of materials having far more favourable electrical properties than those of the known radomes. Owing to the considerable thickness d of

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the retardation lens, special strength properties, such as those required in the case of a radome, are not necessary, so that the material can be selected from a purely electrical point of view. In this connection a small dielectric constant must be used, as the lens thickness d then increases and the reflections on the limiting surfaces of the lens remain small. If the lens is made, for example, of a p.t.f.e. plastic known as TEFLON (a Registered Trade Mark), a dielectric constant ϵ of 2.1 will be accompanied by a very favourable refraction index $n=\sqrt{\epsilon}=1.45$. The loss angle $\tan \delta=2\times 10^{-4}$ of this material is two powers more favourable than that of the materials usually used for radomes. Calculations have shown that with this loss angle the internal losses of a retardation lens of this kind can be disregarded.

WHAT WE CLAIM IS:—

1. Directional aerial for flying bodies, particularly for use in the cm and mm wavelength range, comprising a primary horn radiator and an axially symmetrical dielectric retardation lens having a non-convex surface facing the primary radiator, the focal length and refractive index of the lens being such that the other surface of the lens forms the nose of the flying body.

2. Directional aerial in accordance with Claim 1, wherein a means is provided for deviating the direction of radiation.

3. Directional aerial in accordance with Claim 1 or 2, wherein the flying body rotates about its longitudinal axis and the main direction of radiation from the directional aerial is inclined with respect to the longitudinal axis of the flying body.

4. Directional aerial in accordance with any one of the Claims 1 to 3, wherein the convex part of the retardation lens, which forms the nose of the flying body, is provided with a harder dielectric coating integral with the lens.

5. Directional aerial in accordance with any one of Claims 1 to 4, wherein the primary radiator is a pyramid-shaped horn which extends to the rear edge of the lens.

6. Directional aerial in accordance with Claims 1 to 5, wherein the lens is of a material having a small dielectric constant ϵ, the lens thus having a small refractive index.

7. Directional aerial substantially as herein described with reference to Figures 2, 3 or 4 of the accompanying drawings.

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1,127,274 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale.*

Fig.1

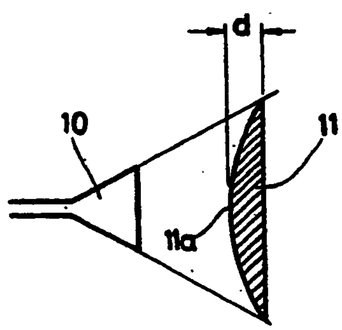


Fig.2

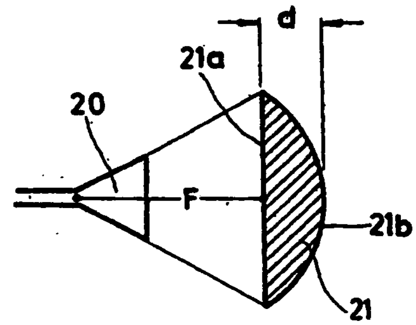


Fig.3

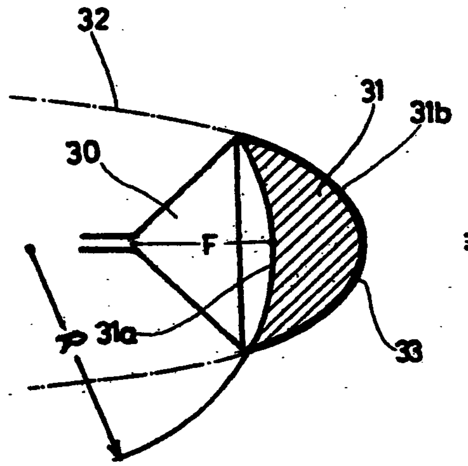
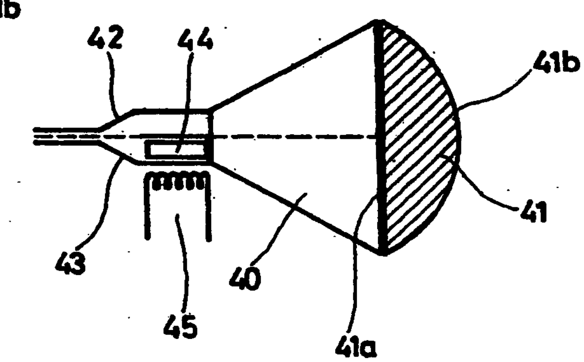


Fig.4



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